Science in Motion - Ursinus College

https://www.ursinus.edu/offices/science-in-motion/

Chemistry Activities – High School

Alternative Energy:

Solar panels: Students compare the efficiency of solar panels exposed to light at different angles. (45 minutes)

Fuel cell cars: Students use solar panels to induce electrolysis of water and collect the hydrogen produced. The hydrogen is then used to run fuel cell cars. Students may also calculate the mpg for the fuel cell cars and compare that to traditional gasoline cars. (45-90 minutes; 1-2 class periods)

Synthesizing biofuels: Students synthesize biodiesel from vegetable oil (45-60 minutes)

Heat energy of fuels: Students calculate the heat/energy produced from burning various fuels. Discussion at the end can lead to the pros & cons of using biodiesel and/or ethanol in our automobiles. (45-90 minutes; 1-2 class periods)

Solar homes: Students study the effects of thermal mass in passively heating a solar home. (45-60 minutes)

Boyle's Law

Uses a LabQuest and gas pressure sensor to determine the relationship between pressure and volume of the gas, and then predict the pressure at other volumes.

Density

Students will predict if a material will sink or float. Then they will measure mass and volume to determine density of a variety of cubes (metals, woods, plastics). They also determine density from the linear regression line of a mass vs volume graph. Finally, they will find percent error by comparing the calculated mass vs actual mass of a block.

Electrolytes

Students experiment with strong, weak, and non-electrolytes using a conductivity probe to measure the conductivity of solutions. Students also investigate the conductivity of solutions resulting from compounds that dissociate to produce different numbers of ions.

Emission Spectra

Uses a LabQuest and Vernier SpectroVis to determine the emission spectra of various salt solutions (flame test method). After spectra are collected and wavelengths are determined, students calculate the energy of the wavelengths emitted.

Uses a LabQuest, SpectroVis, and Vernier Emissions Spectrum Tube Carousel to study the spectra of 6 known gases, then determine the identity of an unknown gas.

Equilibrium & Le Chatelier's Principle

Le Chatelier's Principle: observe how changes affect a system at equilibrium $Co(H_2O)_6^{2+} + Cl^- \rightleftharpoons CoCl_4^{2-} + H_2O$. Students add various reagents (water, HCl) and observe the changes that occur.

Finding K_c: Uses a LabQuest and Vernier Colorimeter to experimentally determine the equilibrium constant, K_C, for: $Fe^{3+}(aq) + SCN^-(aq) \longleftrightarrow FeSCN^{2+}(aq)$. Students prepare four equilibrium systems containing different concentrations of these three ions. The equilibrium concentrations of the three ions are then experimentally determined, and the values are substituted into the equilibrium constant expression to see if K_C is indeed constant.

FTIR (Fourier-transform infrared spectroscopy)

Our FTIR spectrometer is used in a variety of activities: identification of fibers and fabrics in a forensic analysis, to obtain spectra of several pure liquids and identify an unknown, to compare and identify adhesive tape and labels, and to analyze and identify plastics. This equipment can also be borrowed and used for other activities that fit your curriculum.

Gas Chromatography

The Vernier mini-GC is used to measure and analyze the retention times of known ketones and ketone mixtures, then identify an unknown ketone. This equipment is also used in a forensics setting, to identify an unknown liquid.

Heat Energy of Fuels

Students determine the heat energy of various fuels and compare them to ethanol and biodiesel. This is both a good activity for chemistry students and environmental studies students.

Melting Point

We have both Vernier Melt Stations and Mel-Temps. Students use this equipment to determine melting points of compounds – to learn about melting points, to identify an unknown compound, and to verify a compound synthesis and/or purity.

Microscale Synthesis

Students synthesize esters and/or aspirin.

Nuclear Radiation

Students study nuclear radiation with small radioactive sources of Polonium-210, Strontium-90, and Cobalt-60. Activities can include some or all of the following: the penetrating ability of alpha, beta, and gamma radiation; the effect of distance on nuclear radiation; shielding and radiation.

Periodic Table Review – using Spheros

We have large periodic tables available. Teachers can ask a question, and students can drive Spheros to the correct location on the periodic table. Students can also program the Spheros to display the answer (up to two characters). Contact us for suggestions / help planning a unique lesson or review session!

Rate Laws

Solubility product constant: Using a spectrophotometer, students determine the solubility product constant of copper (II) tartrate.

Rate Law & Order of the Reaction: Using a spectrophotometer, students determine the rate law and order of a reaction between food coloring and bleach.

Review / Test prep activities

We can design fun, unique review sessions for nearly any topic using our programmable Spheros. (No prior programming experience needed.) Ask us for suggestions for your next review session!

Soil Analysis

Comparison of potting soil to ground soil: students use probes to measure temperature, moisture, pH, conductivity/salinity, calcium, chloride, ammonium, and nitrate in potting soil and ground soil. An add-on is to compare plants grown in potting soil to those grown in ground soil.

Soil temperature: Students measure the temperature changes in soil from differing depths, daytime, and nighttime.

Spectrophotometric Analysis

Analysis of sunblock: students use a UV-Vis spectrometer to investigate the differences in a variety of sunblocks, and determine the most effective sunblock.

Analysis of aspirin: students determine the amount of aspirin in a commercial aspirin product.

Atomic Emissions Spectra: Uses a LabQuest and Vernier Emissions Spectrum Tube Carousel to study the emissions of 6 known gases, then determine the composition of an unknown mixture.

Beer's Law: students measure the relationship between concentration and absorbance, then use this equation to determine the concentration of an unknown solution.

Chlorophyll in Olive Oil: Students measure the spectra of three standard olive oils, then identify an unknown olive oil.

Flame testing: Students determine the emission spectra of various salt solutions. After spectra are collected and wavelengths are determined, students calculate the energy of the wavelengths emitted.

Solubility product constant: Students determine the solubility product constant of copper (II) tartrate.

Rate Law & Order of the Reaction: Students determine the rate law and order of a reaction between food coloring and bleach.

Visible spectra of commercial dyes: Students measure the spectrum of various dyes and dye mixtures, then identify the dyes in an unknown mixture.

Spheros

Spheros are paired with a Kindle Fire (provided) through the SpheroEdu app. Beginners can draw a path for the Sphero robot to follow, intermediate users can drag and drop blocks of code, and

advanced users can write text programs using JavaScript. Provide your own activities, or use one of the SpheroEdu prepared modules aligned to NGSS, CCSS, and various state standards.

Stoichiometry of a Reaction

Students measure the stoichiometry / mole ratio of a reaction by using a temperature probe to measure the amount of heat evolved.

Thin Layer & Paper Chromatography

Analgesics: Students run TLC on acetaminophen, aspirin, caffeine, ibuprofen and/or naproxen. They then identify an unknown analgesic.

Ink: Students run TLC on various inks to determine an unknown ink sample (often designed as a forensics experiment).

Lipstick: Students run TLC on lipstick samples, then match an unknown sample to one of the knowns (often designed as a forensics experiment).

Marker: Students use paper chromatography to separate the inks in markers, then identify an unknown marker (often designed as a forensics experiment).

Verification of Esterification

Students conduct the reaction between ethyl alcohol and acetic acid, then confirm the production of the ester ethyl acetate with a Vernier Mini GC.

Equipment List:

Atomic Emission Spectra: spectrometers, spectrum tubes, and accessories
Flex Cams
LabPros
LabQuests
Macropipettes (0.5 – 5mL)
Micropipettes (2-20uL)
Molecular model kits
pH meters
Spec 20s
FTIR spectrometers
UV/Vis spectrometers
Vernier Mini Gas Chromatographs

Vernier Probes:

- Salinity
- Conductivity
- Current
- Charge
- Differential voltage
- Voltage
- CO_2 gas
- O_2 gas
- Chloride ion
- Calcium ion
- Nitrate ion
- Ammonium Ion
- Turbidity
- Colorimeter
- Melt Station
- Dissolved Oxygen
- Light Sensor
- Soil Moisture

UVA	Radiation
UVB	Spectro Vis Optical Fiber
Gas Pressure	SpectroVis & SpectroVis Plus
pH	UV/Vis spectrophotometer
Temperature	Fluorometers

We are always working on new activities to bring to your classroom. If you have any curriculum for which you do not see an activity, please let us know! We may be able to design one for you.